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Final Report: Oxidative stress, stress resistance, and longevity in Apis mellifera

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6. AUTHORS
Micheline Strand, David Tarpy, Olav Rueppell, Hongmei Li-Byarlay, Ming Huang, Michael Simone-Finstrom

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAMES AND ADDRESSES
North Carolina State University
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The views, opinions and/or findings contained in this report are those of the author(s) and should not contrued as an official Department of the Army position, policy or decision, unless so designated by other documentation.

14. ABSTRACT
For studies conducted in Years 1 and 2 of this project, thousands of samples have been processed. Year 1 examined variation within colonies and among individuals to identify behavioral markers of stress resistance and the possible genetic underpinnings of oxidative stress, including paternal or maternal effects. In the second field season, we performed experiments in more of a top-down manner, more thoroughly examining how environmental, colony-level factors influence individual longevity, oxidative damage and stress resistance. This is an area that has not been previously examined at this level and will produce a significant amount of information (e.g., how management

15. SUBJECT TERMS
oxidative stress

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a. REPORT	b. ABSTRACT	c. THIS PAGE			Micheline Strand
UU	UU	UU	UU		19b. TELEPHONE NUMBER 919-549-4343

Report Title

Final Report: Oxidative stress, stress resistance, and longevity in Apis mellifera

ABSTRACT

For studies conducted in Years 1 and 2 of this project, thousands of samples have been processed. Year 1 examined variation within colonies and among individuals to identify behavioral markers of stress resistance and the possible genetic underpinnings of oxidative stress, including paternal or maternal effects. In the second field season, we performed experiments in more of a top-down manner, more thoroughly examining how environmental, colony-level factors influence individual longevity, oxidative damage and stress resistance. This is an area that has not been previously examined at this level and will produce a significant amount of information (e.g., how management practices may directly impact stress levels) that will lead to a host of new questions for future investigation. With the addition of a new postdoctoral researcher, training and optimization of methods occurred in the middle of the fourth field season. For the third field season, we have submitted a manuscript for publication comparing honey bee drones (males) in their susceptibility vs. resistance to oxidative challenge. We have also completed the analysis of the Year 2 samples for the following comparisons: (1) Stationary vs. Migratory vs. Intense Migratory and (2) young In-Hive Workers vs. old Foragers. Three measures of oxidative stress were measured: (1) DNA oxidation, (2) protein carbonyl, and (3) lipid peroxidase. These results are currently being written up for a submission to Scientific Reports.

Enter List of papers submitted or published that acknowledge ARO support from the start of the project to the date of this printing. List the papers, including journal references, in the following categories:

(a) Papers published in peer-reviewed journals (N/A for none)

Received	Paper

TOTAL:

Number of Papers published in peer-reviewed journals:

(b) Papers published in non-peer-reviewed journals (N/A for none)

Received	Paper

TOTAL:

Number of Papers published in non peer-reviewed journals:

(c) Presentations

Li-Byarlay, H., H. F. Boncristiani, M. Strand, D. R. Tarpy, and O. Rueppell. (2015). Transcriptomic analysis of lethal IAPV infection in honey bee pupae. ESA Meeting, Minneapolis MN.

Li-Byarlay, H., H. F. Boncristiani, M. Strand, D. R. Tarpy, and O. Rueppell. (2015). Transcriptomic analysis of lethal IAPV infection in honey bee pupae. Biology & Genomics of Social Insects Conference, Cold Springs Harbor Laboratory, NY

Li-Byarlay, H., M. H. Huang, M. Strand, D. R. Tarpy, and O. Rueppell. (2015). Effects of oxidative stress in the honey bee drones. ABRC Meeting, Tucson AZ.

Li-Byarlay, H., M. Simone-Finstrom, M. Huang, M. Strand, O. Rueppell, and D. R. Tarpy. (2014). Effects of honey bee management on oxidative stress and longevity. ESA Meeting, Portland OR.

Number of Presentations: 4.00

Non Peer-Reviewed Conference Proceeding publications (other than abstracts):

Received Paper

TOTAL:

Number of Non Peer-Reviewed Conference Proceeding publications (other than abstracts):

Peer-Reviewed Conference Proceeding publications (other than abstracts):

Received Paper

TOTAL:

Number of Peer-Reviewed Conference Proceeding publications (other than abstracts):

(d) Manuscripts

Received		Paper
07/21/2014	1.00	Boncristiani, H.F.,, Evans, J.D., , Chen, Y., , Pettis, J., , Murphy, C.,, Lopez, DL, , Simone-Finstrom, , M. Strand, M., , Tarpy, D.R., and, Rueppell, O. In vitro infection of pupae with Isareli acute paralysis virus suggests disturbance of transcriptional homeostasis in honey bees (Apis mellifera) , PLoS ONE (09 2013)
12/23/2015	2.00	Ming Hua Huang, Michael Simone-Finstrom, Micheline Strand, David Tarpy, Hongmei Li-Byarlay, Olav Rueppell. Honey bee (Apis mellifera) drones resistant to paraquat exhibit increased tolerance, not avoidance or repair, of oxidative damage., The Science of Nature (08 2015)
TOTAL:		**2**

Number of Manuscripts:

Books

Received	Book
TOTAL:	

Received	Book Chapter
TOTAL:	

Patents Submitted

Patents Awarded

Awards

None.

Graduate Students

NAME	PERCENT_SUPPORTED
FTE Equivalent:	
Total Number:	

Names of Post Doctorates

NAME	PERCENT_SUPPORTED
Ming Huang	0.00
Mike Simone-Finstrom	0.00
Hongmei Li-Byarlay	0.00
FTE Equivalent:	**0.00**
Total Number:	**3**

Names of Faculty Supported

NAME	PERCENT_SUPPORTED	National Academy Member
David Tarpy	0.00	
Olav Rueppell	0.00	
FTE Equivalent:	**0.00**	
Total Number:	**2**	

Names of Under Graduate students supported

NAME	PERCENT_SUPPORTED	DISCIPLINE
Ravi Dixit	50	
Jason Brannock	0	
Sam Freeze	0	
FTE Equivalent:	**0.50**	
Total Number:	**3**	

Student Metrics

This section only applies to graduating undergraduates supported by this agreement in this reporting period

The number of undergraduates funded by this agreement who graduated during this period:	1.00
The number of undergraduates funded by this agreement who graduated during this period with a degree in science, mathematics, engineering, or technology fields:	1.00
The number of undergraduates funded by your agreement who graduated during this period and will continue to pursue a graduate or Ph.D. degree in science, mathematics, engineering, or technology fields:	1.00
Number of graduating undergraduates who achieved a 3.5 GPA to 4.0 (4.0 max scale):	1.00
Number of graduating undergraduates funded by a DoD funded Center of Excellence grant for Education, Research and Engineering:	0.00
The number of undergraduates funded by your agreement who graduated during this period and intend to work for the Department of Defense	0.00
The number of undergraduates funded by your agreement who graduated during this period and will receive scholarships or fellowships for further studies in science, mathematics, engineering or technology fields:	0.00

Names of Personnel receiving masters degrees

NAME
Total Number:

Names of personnel receiving PHDs

NAME
Total Number:

Names of other research staff

NAME	PERCENT_SUPPORTED
Jennifer Keller	0.00
FTE Equivalent:	**0.00**
Total Number:	**1**

Sub Contractors (DD882)

Inventions (DD882)

Scientific Progress

For studies conducted in Years 1 and 2 of this project, thousands of samples have been processed. Year 1 examined variation within colonies and among individuals to identify behavioral markers of stress resistance and the possible genetic underpinnings of oxidative stress, including paternal or maternal effects. In the second field season, we performed experiments in more of a top-down manner, more thoroughly examining how environmental, colony-level factors influence individual longevity, oxidative damage and stress resistance. This is an area that has not been previously examined at this level and will produce a significant amount of information (e.g., how management practices may directly impact stress levels) that will lead to a host of new questions for future investigation. With the addition of a new postdoctoral researcher, training and optimization of methods occurred in the middle of the fourth field season. For the third field season, we have submitted a manuscript for publication comparing honey bee drones (males) in their susceptibility vs. resistance to oxidative challenge. We have also completed the analysis of the Year 2 samples for the following comparisons: (1) Stationary vs. Migratory vs. Intense Migratory and (2) young In-Hive Workers vs. old Foragers. Three measures of oxidative stress were measured: (1) DNA oxidation, (2) protein carbonyl, and (3) lipid peroxidase. These results are currently being written up for a submission to Scientific Reports.

Technology Transfer

None.